Can You Help Bartholomew Save the Kingdom of Didd from the Oobleck?

Subject Area(s) Physical Science, Problem Solving, Chemistry, and Measurement.
(Select from TE subject areas)

Associated Unit **N/A**

Associated Lesson **N/A**

Activity Title: Can You Help Bartholomew Save the Kingdom of Didd from the Oobleck?

Header


Image 1


Image 2

Image 1
Image File: Image 2 Link
ADA Description: Picture of a gelatinous material shaped somewhat like a worm. It has clear bubbles inside of it and appears to be green, on a green background.
Source/Rights: © Catherine Bulinski
Caption: This is what we're up against.

Image 2
Image File: Image 3 Link
ADA Description: Picture of a Lego minifigure. She has short brown hair, big black glasses, a Batman t-shirt, light brown pants, and a white lab coat. She has an illegible red name tag on, and is carrying a red cup and a black object that appears to be either a notebook or a laptop.
Source/Rights: © Brickset
Caption: Just one of the engineers prepared to tackle this problem.

Grade Level 5th (4-6)

Activity Dependency

Time Required 555 minutes (but flexible)

1. **3-5 students per group**

Expendable Cost per Group US $10-$30

Summary
This activity integrates science, engineering, and language arts. Students will read the book, "Bartholomew and the Oobleck," by Dr. Seuss. I will show them a Lego person and a little castle, covered in Oobleck. Students will then be provided with a sample of Oobleck to study in their lab environments. There they will make observations and research substances that match their observations. They will then be told that the Kingdom of Didd has a limited amount of substances to try to precipitate the Oobleck and save their people. Each substance has an environmental/health and financial cost associated with it. They will use the engineering design process to develop and test their solutions to this problem. When they are ready/time constraints are up, they will test this in their "real world" situation, on their own Lego scene. During this process, they will measure liquids using a mL syringe and solids in grams using an electric scale. They will also create a presentation to communicate their process and results (so they will maintain careful notes in their notebooks and take pictures as evidence). They will also be addressing the theme of the book, be introduced to different types of real precipitation, discuss states of matter, and what happens when certain substances are combined.

Engineering Connection
In this lesson, students will be identifying the problem and researching it. They will design, test, redesign, and select solutions to the problem. Then they will communicate their process and results to others.
(https://www.teachengineering.org/k12engineering/designprocess)
(https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps)

Engineering Category =

Engineering design process

Keywords
precipitate, engineering design process, solid, liquid, solution, mixture, precipitation, microgel, tare, milliliter, gram, protocol, iteration

Educational Standards (List 2-4)
Source, year, standard number(s)/letter(s), grade band and text (its unique ID# is optional)

(http://www.cpalms.org/Public/search/Standard#, 2018)

SC.5.N.1.5

Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method."

SC.5.N.1.1

Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.5.P.8.1

Compare and contrast the basic properties of solids, liquids, and gases, such as mass, volume, color, texture, and temperature.

SC.5.E.7.4

Distinguish among the various forms of precipitation (rain, snow, sleet, and hail), making connections to the weather in a particular place and time.

SC.5.P.8.2

Investigate and identify materials that will dissolve in water and those that will not and identify the conditions that will speed up or slow down the dissolving process.

SC.35.CS-CC.1.1

Identify technology tools for individual and collaborative data collection, writing, communication, and publishing activities.

SC.35.CS-CC.1.2

Describe key ideas and details while working individually or collaboratively using digital tools and media-rich resources in a way that informs, persuades, and/or entertains.

SC.35.CS-CS.1.2

Describe how models and simulations can be used to solve real-world issues in science and engineering.

SC.35.CS-CS.1.3

Answer a question, individually and collaboratively, using data from a simulation.

SC.35.CS-CS.1.4

Create a simple model of a system (e.g., flower or solar system) and explain what the model shows and does not show.

SC.35.CS-CS.2.2

Describe how computational thinking can be used to solve real life issues in science and engineering.

SC.35.CS-CS.2.4

Solve real-world problems in science and engineering using computational thinking skills.

SC.35.CS-CP.1.1

Explain that searches may be enhanced by using Boolean logic (e.g., using not, or, and).

SC.35.CS-CP.1.3

Identify, research, and collect a data set on a topic, issue, problem, or question using age-appropriate technologies.

ITEEA Standards (required)

(Standards for Technological Literacy, 2007)

Technology and Society:

#5. Students will develop an understanding of the effects of technology on the environment.

#6. Students will develop an understanding of the role of society in the development and use of technology.

#8. Students will develop an understanding of the attributes of design.

#9. Students will develop an understanding of engineering design.

#10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

#11. Students will develop the abilities to apply the design process.

#13. Students will develop the abilities to assess the impact of products and systems.

#17. Students will develop an understanding of and be able to select and use information and communication technologies.

NGSS Standards (strongly recommended)

(Nextgenscience.org, 2018)
5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

CCSS Standards (strongly recommended)

(Corestandards.org, 2018)

CCSS.ELA-Literacy.RL.5.2

Determine a theme of a story, drama, or poem from details in the text, including how characters in a story or drama respond to challenges or how the speaker in a poem reflects upon a topic; summarize the text.

CCSS.ELA-Literacy.RL.5.10

By the end of the year, read and comprehend literature, including stories, dramas, and poetry, at the high end of the grades 4-5 text complexity band independently and proficiently.

CCSS.ELA-Literacy.RL.5.1

Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

CCSS.ELA-Literacy.SL.5.4

Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

CCSS.ELA-Literacy.SL.5.5

Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

CCSS.ELA-Literacy.SL.5.6

Adapt speech to a variety of contexts and tasks, using formal English when appropriate to task and situation. (See grade 5 Language standards 1 and 3 here for specific expectations.)

CCSS.Math.Content.5.MD.A.1

Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

Pre-Requisite Knowledge

- Grade level appropriate science background knowledge.

Learning Objectives

After this activity, students should be able to:

- Explain the differences between solids and liquids
- Use an electronic scale to tare and measure, and measure in mL with a syringe
- Take accurate and thorough notes in their lab notebooks
- Create a multimedia presentation to present their engineering design process
- Explain how engineers approach problem solving/explain the engineering design process

Materials List

Each group needs:

- Scoop Spatula https://www.amazon.com/gp/product/B00BLS7FNK/ref=ox_sc_sfl_title_22?ie=UTF8&psc=1&smid=ATVPDKIKX0DER Model Number CH0635A UNSPSC Code 42294001 UPC 849230026813
- Lego person, several Legos to make a small castle, and a white Brick Base Plate https://www.amazon.com/gp/product/B07C3LPBZC/ref=ox_sc_sfl_title_26?ie=UTF8&psc=1&smid=A1Z9Y2OA9BKKFA ASIN B07C3LPBZC https://www.amazon.com/gp/product/B017EUXEF6/ref=ox_sc_sfl_title_16?ie=UTF8&psc=1&smid=ATVPDKIKX0DER ASIN B017EUXEF6 Item model number CNP0233 https://www.amazon.com/gp/product/B01ENI2HBY/ref=ox_sc_sfl_title_15?ie=UTF8&psc=1&smid=A1CC1KRZAM6JUS ASIN B01ENI2HBY
- Plastic swizzle sticks for stirring https://www.amazon.com/gp/product/B010TR0BXY/ref=ox_sc_sfl_title_2?ie=UTF8&psc=1&smid=AGBKL9RKMCR7 ASIN B010TR0BXY
- Material Costs List

- Lab notebooks for each student

To share with the entire class:

- Device capable of taking digital photos/videos. If you have access to several, one per lab group would be ideal, but not necessary.
- Posterboards
- IPads/laptops/computers
- A copy of the book, *Bartholomew and the Oobleck,* by Dr. Seuss. https://www.amazon.com/gp/product/0394800753/ref=ox_sc_sfl_title_12?ie=UTF8&psc=1&smid=ATVPDKIKX0DER **ISBN-10:** 0394800753 **ISBN-13:** 978-0394900759
- Substance Translation Document (for the END of the entire activity)
- A digital scale that can tare and read in grams and milligrams. https://www.amazon.com/gp/product/B01HCKQG7G/ref=ox_sc_sfl_title_3?ie=UTF8&psc=1&smid=A2W7SVTYX2YVVN ASIN B01HCKQG7G
- Small bottles for holding the substances (at least the hydrogen peroxide needs to be kept in an opaque container). https://www.amazon.com/gp/product/B01HCKQG7G/ref=ox_sc_sfl_title_3?ie=UTF8&psc=1&smid=A2W7SVTYX2YVVN **ASIN:** B071XS3S4T https://www.amazon.com/gp/product/B01MR4FNHQ/ref=ox_sc_sfl_title_6?ie=UTF8&psc=1&smid=A5WH31F4NTA2F **ASIN:** B01MR4FNHQ **UPC:** 761290913110
- Labels for the bottles
- Gloves (plastic or vinyl)
- 5 mL Oral dispenser syringes https://www.amazon.com/Dispenser-Medicine-Syringes-Care-Touch/dp/B01N1RZAJG/ref=sr_1_1_sspa?s=hpc&ie=UTF8&qid=1530731000&sr=1-1-spons&keywords=oral+syringes&psc=1 UPC 370393538016
- Clear 5 gram plastic pot jars/cosmetic containers with lids https://www.amazon.com/gp/product/B00J7A4SAW/ref=ox_sc_sfl_title_13?ie=UTF8&psc=1&smid=A1IDUWSGVW0BD **ASIN:** B00J7A4SAW **UPC:** 794168024250 763109951627 857836003060
- Sun laboratories Aloe Vera Gel https://www.amazon.com/gp/product/B0054L57P8/ref=ox_sc_sfl_title_12?ie=UTF8&psc=1&smid=A324JRQB0MJZXB **ASIN:** B0054L57P8 **UPC:** 753843200402
- A "Hazardous Waste" disposal container (A glass one decorated with a Halloween image, like a skull, is particularly fun)
- Different substances for designing solutions for collapsing the Oobleck. If you can't buy them all, or there is a difference in brand, that is okay as long as there is a variety.
    - S. Pellegrino Sparkling Natural Mineral Water
    - Morton Iodized salt

- Acure Dry Shampoo (powder) https://www.amazon.com/gp/product/B01HXMOU26/ref=ox_sc_sfl_title_2?ie=UTF8&psc=1&smid=A3S7QBCXJ4O1G0 **ASIN:** B01HXMOU26
- Dawn Platinum Erasing Dishwashing Foam Refill (it is important for it to be a foaming soap so that its consistency is less viscous) https://www.amazon.com/gp/product/B00KB8Z9RK/ref=ox_sc_sfl_title_4?ie=UTF8&psc=1&smid=ATVPDKIKX0DER **ASIN:** B00KB8Z9RK
- Hydrogen Peroxide
- Natural Epsom Salt
- Imperial Sugar Dixie Crystals Pure Cane Sugar https://www.amazon.com/gp/product/B01M1I080U/ref=ox_sc_act_title_1?smid=A14LD3TETE82LQ&psc=1 **UPC:** 016200337006

Introduction / Motivation

The Dr. Seuss-themed pre-assessment, reading the story "Bartholomew and the Oobleck," the engineering video, and showing them the Lego situation.

Vocabulary / Definitions

Word	Definition
precipitating	Condensing the polymer chains that make up the microgel (T. Angelini).
engineering design process	An iterative process that helps solves problems. https://www.teachengineering.org/k12engineering/designprocess
solid	The state of matter with a definite shape and volume. http://www.harcourtschool.com/glossary/science/index5.html
liquid	The state of matter with a definite volume, but not a definite shape. http://www.harcourtschool.com/glossary/science/index5.html
solution	When a substance is dissolved in a liquid. https://www.merriam-webster.com/dictionary/solution
mixture	When two or more substances are mixed together.
precipitation	Water that falls from clouds. http://www.harcourtschool.com/glossary/science/index5.html
microgel	A very swollen, very small polymeric ball (Bhattacharjee, 2015).
tare	Setting a scale to measure at 0 when it has a vessel on it.
milliliter	A scientific unit of volume.
gram	A scientific unit of mass.
protocol	Rules for completing a procedure.
iteration	Repeating a process. https://www.merriam-webster.com/dictionary/iteration

Lesson Background & Concepts for Teachers

It is important for teachers to become familiar with the engineering design process, the use of an electronic scale, mass and volume in metric units, and the use of a syringe.

There is a substance within the aloe gel that causes its unique properties...carbomer. This carbomer is a microgel, which contains "cross-linked poly(acrylic acid) copolymers" (LeBlanc et al., 2016). Substances with carbomer in them can seem like liquids (for example, hand sanitizer or aloe gel), but they are technically solids. This can be shown through the fact that the bubbles in them never rise if left undisturbed. However, if they are moved, they act like a liquid (T. Angelini.) Think of it like a ball pit (T. Angelini). It is a solid, but when walked through it behaves a lot more like a liquid (T. Angelini). Carbomer can be classified as a Liquid Like Solid (C. O'Bryan). Carbomer can be precipitated when the pH changes (C. O'Bryan). This can be accomplished by adding salt to it (C. O'Bryan). Also, we found in our lab that dish soap accomplishes this as well (A. Brady-Mine).

Procedure

Day 1

Before

- Print pre-assessment
- Pull up websites/videos

With the Students

1. Provide the engineering and science pre-assessment.
2. Watch engineering video http://thefutureschannel.com/what-is-engineering/
    - ***Investigating Questions***
        - What is an engineer?
        - How can you be an engineer?

Day 2

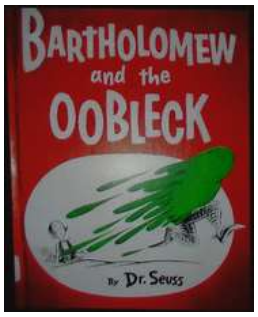

Image 3

Image 3
Image File: Image 1 Link
ADA Description: Picture of an orange book with the text "Bartholomew and the Oobleck by Dr. Seuss" There is a mostly black and white illustration of a scared little boy looking at a person who is running away, covered in green slime.

Source/Rights: © K.W. Barrett
Caption: We must help Bartholomew defeat the Oobleck!

Before
- Obtain "Bartholomew and the Oobleck" in print or via YouTube.
- Print the language arts questions

With the Students
1. Read the book as a class, individually, or in pairs/groups. You can also access this book on YouTube at https://www.youtube.com/watch?v=E84Omy5DDYY .
2. Language Arts Questions (McCarthy & Tessmann, 2018). There are two sets of questions. Therefore, one can be used for modeling, group or partner work, or to be done with the teacher, and one can be done independently (or at least with less support).

- ***Investigating Questions***
    - Do you see anything related to engineering in this story?

Day 3

Image 4

Image 4
Image File: Photographed by Kayla Bock
ADA Description: A teacher stands behind a table of supplies, wearing a lab coat and a Dr. Seuss Cat in the Hat hat. She is holding her Lego kingdom. There are other Lego kingdoms on the table, along with the "rain" (A cup of water).
Source/Rights: Crystal Tessmann
Caption: The Principal Investigator preparing her engineers to test their final designs.

Before
- Prepare to pull up Engineering Design from Teach Engineering. Prepare a model notebook.
- Build teacher Lego scene (person, white base, little castle) and prepare syringe of water.
- If you have a lab coat, put it on!

With the Students

1. Tell students that unfortunately, the ending of the book never happened, and the kingdom is going to have to rely on engineers to solve the problem of the Oobleck instead. Tell them that you are the Principal Investigator (PI) for this engineering project and explain what that means.
2. We are going to have to prepare ourselves to be these good engineers.
3. Introduce Engineering design process. Brainstorm ways to be good engineers based on the video from Day 1 and the engineering design process discussed today. Throughout the lesson, refer to what stage in the engineering design process we are in.
4. Discuss lab notebook expectations. Show them the Lab Notebook Grading Criteria document.
5. Show teacher Lego scene. Show how rain (water squirted from a syringe) alone is not effective in removing the Oobleck quickly.
6. Discuss/define the problem using the scene and the text/illustrations in the book. Write the problem on an Anchor Chart and have them copy it into their notebooks. Throughout the lesson, refer to what stage in the engineering design process we are in: **Identify the Need**.

- ***Investigating Questions***
    - Why is the Oobleck a problem?
    - Why do we care?
    - What is a PI? What do they do?

<u>Day 4</u>

Before

- Copy the Materials Cost paper, Safety Agreement, Lab Document, Final Rubric, and Responsibilities Sheet.
- Cue up any necessary YouTube videos, such as this one for Boolean Search terms http://www.watchknowlearn.org/Video.aspx?VideoID=837&CategoryID=157
- Place the Aloe Vera gel in clear bottles and label it "Oobleck" with the stickers.
- Prepare remaining lab materials
- Place (Morton Iodized salt, Acure dry shampoo powder, hydrogen peroxide, natural epsom salt, and cane sugar into the white bottles).
- Place the other substances that are intended for collapsing the Oobleck in their new containers (S. Pellegrino Sparkling Natural Mineral Water, and Dawn Platinum Erasing Dishwashing Foam Refill in the clear bottles and label them with the stickers and their Seuss translated name)
- Prepare to take pictures throughout the lab to help them create their presentations.
- Prepare the Hazardous Waste container

With the Students

1. Introduce the substances available for collapsing the Oobleck.
2. Explain what constraints are. Hand out the Materials Costs paper. Explain additional constraints (Oobleck cannot be taken out of the room etc.). They have 1,000 Whodollars to spend. Any left over money can be used

for a Who-lebration (this can be determined by the teacher…they can use Whodollars to purchase "movie time," candy, etc.). **Identify the Constraints.**

3. Show them the Final Rubric so they know what they are working towards.
4. Tell students they will soon be given access to samples of Oobleck that were found in a ditch, to study in their "labs." Have them give their labs a name.
5. Introduce lab safety standards using these websites (https://www.youtube.com/watch?v=MEIXRLcC6RA https://www.youtube.com/watch?v=5g0hNM91iyg ; The Amoeba Sisters video can be show in totality, choose a part or two from the second video—the tying hair back for fire safety portion is particularly amusing),personal protective equipment (PPE),working with others in a lab, waste disposal, and MSDS.
6. Discuss making observations and how we will use our observations to do research. Discuss Boolean search terms/watch video. Provide them with the Lab Document and Responsibilities Sheet.
7. Provide students with Scoopula, cosmetic container, sample of Oobleck, gloves and glove holder, safety goggles, hand lens, white paper, paper towels.
8. Allow for time to make observations, and for them to search Kiddle for the Oobleck using their search terms. Guide them through narrowing their results and restating their search terms. Have them take notes about what the substance might be and what it is probably not, based on their research and observations. If they find what they think it is, have them try to research how to get rid of it. **Research the Problem.**
9. Discuss their findings. Discuss how we need to design a solution based on our research/observations or just our best guess.

- ***Investigating Questions***
    - Do you think engineers ever do research and not find what they are looking for?
    - Why do engineers do research?
    - Does researching and not finding the answer have any benefits?
    - Why do engineers make observations?
    - How is making an engineering observation different than making a scientific observation? How is it the same?
    - Why do we have safety rules?
    - How do we use each of these tools?
    - As you look at these materials costs, are there any you aren't willing to explore?

Day 5

Image 5

Image 5
Image File: Photographed by Crystal Tessmann/Kayla Bock
ADA Description: A male fifth grader sits at a table. He is writing in his design plan and has a copy of the material constraints next to him.
Source/Rights: Crystal Tessmann, permission to print provided by guardian.
Caption: An engineer writing on his design plan.

Before

- Prepare remaining laboratory tools
- Copy the Planning and Approval document

With the Students

1. Introduce their remaining engineering laboratory tools and practice using them. This is especially important for the digital scale and syringes. Discuss mL and grams.
2. Review safety procedures.
3. Show them the planning and approval document.
4. Have them develop a plan for 2 ways to precipitate the Oobleck. Have them submit it to the PI. **Imagine: Develop possible solutions. Plan: Select a promising solution**.

- ***Investigating Questions***
    - What are milliliters? Why do we use them?
    - What are grams? Why do we use them?
    - Why is it important to make a plan?
    - Why do engineers submit design plans to a PI?
    - What do you do if you disagree with your lab mates about a design?
    - What are you going to do if the PI doesn't accept your design?
    - Is it okay to fail? What do engineers do when they fail?

Day 6

Image 6

Image 6
Image File: Photographed by Crystal Tessmann/Kayla Bock
ADA Description: A female fifth grader stands at a table. She is wearing protective gloves and safety glasses. The table contains scoopulas and NaNupp Dust in a white plastic bottle. Students are working behind her at their lab tables. A dialogue bubble states "Member of the Oobleck Catchers Lab."
Source/Rights: Crystal Tessmann, permission to print provided by guardian.
Caption: An engineer ready to obtain her supplies.

Before

- Review their submissions and provide written feedback
- Prepare the classroom for the lab

With the Students

1. Allow them to begin testing and evaluating their designs (evaluation sheet)/alternatively have students revise their submissions and/or create new ones. **Create: Build a prototype. Test and evaluate prototype. Improve: Redesign as needed.**

- ***Investigating Questions***
  - How effective was your design?
  - What adjustments do you need to make?
  - Can you make improvements?
  - If it didn't work, what did you learn?

<u>Day 7</u>

Before

- Look at their evaluation sheets and additional or revised designs, prepare feedback and prepare to help them along if they are struggling.

With the Students

1. Continue working. **Redesign as needed.**
2. Have each lab select their most effective solution and video tape it.

- ***Investigating Questions***
  - How effective was your design?
  - What adjustments do you need to make?
  - Can you make improvements?

- If it didn't work, what did you learn?
- Why did you choose this as your most effective design?

Days 8-10

Image 7

Image 7
Image File: Photographed by Crystal Tessmann/Kayla Bock
ADA Description: Two female fifth graders stand at the front of the classroom. The one on the left is speaking into a microphone. They have their poster presentation illuminated and hung on the board. The poster has pictures and writing, and is visually appealing. Other students sit and listen.
Source/Rights: Crystal Tessmann, permission to print provided by guardians.
Caption: Two engineers presenting their work to their engineering community.

Before

- Load their videos on computers, and any pictures taken throughout the experience. Also, load "stock" photos of objects from our lab. Alternatively, you can provide each group with a posterboard to create a hard copy presentation.
- Prepare any necessary technology or supplies for students to make their presentations

With the Students

1. Make presentations and practice giving them. **Sharing their work with the engineering community.**
2. This time can also be used for groups to continue revising their designs if they needed more time.
3. Groups that finish early can begin rewriting and illustrating the ending of Bartholomew and the Oobleck with labs' individual designs. They can visit http://www.seussville.com/ to make themselves into characters if they would like, and these can be printed out as part of their illustrations.

- ***Investigating Questions***
  - What will make this presentation credible to the engineering community?

Day 11

Before

- Prepare teacher copies of Final Rubric

With the Students

1. Establish listening procedures
2. Students give presentations. **Sharing their work with the engineering community.**

- ***Investigating Questions***
    - What have you learned from listening to other engineers?

Day 12

Before

- Copy Post-assessment
- Complete the part of the rubric that can be done before the Post-assessment

With the Students

1. Have them take their post-assessments.
2. Have students continue/begin rewriting/sharing the ending of Bartholomew and the Oobleck with their individual designs while you grade their post assessments.
3. Hand back graded pre and post assessments, discuss and correct.
4. Hand back final project rubric.
5. Celebrate their accomplishments as engineers. Reveal the true identity of the substances. Ideally, their work could be presented later at a Parent Night.

- ***Investigating Questions***
    - How will you be an engineer this year?

Attachments

Safety Issues

- All the substances are relatively safe, but none should be ingested, inhaled, or put in someone's eye.

Troubleshooting Tips

- Try this yourself ahead of time.
- Establish procedures for asking you for help so that it is an organized activity and frustrations are minimized.

Investigating Questions

See each day for these questions.

Assessment

Pre-Activity Assessment

Pre-Assessment: This is a seven question assessment that addresses engineering, nature of science, precipitation, and properties of matter. The first six questions are FCAT-style/multiple choice. The last question is open-ended.

Activity Embedded Assessment

Design Plan/Application: This worksheet is in table form, and ask students to request materials, explain their procedure, make a prediction about the outcome of their procedure. It has a place for the PI to accept it or provide other feedback.

Post-Activity Assessment

Post-Assessment: This assessment is identical to the pre-assessment, except it has one additional open-ended question, How have you behaved like an engineer during this project?

Activity Extensions

Students can write a Dr. Seuss themed story about the engineering design process.

Activity Scaling

- For lower grades, most of this can be accomplished as long as it is done with an adult. The language of the pre and post assessments should be changed to be a simpler reading level, or possibly limited to the open-ended questions.
- For higher grades, this may not be engaging. If you feel that it is, then more independence can be allowed.

Additional Multimedia Support

References

Professor Tommy Angelini, University of Florida

Chris O'Bryan, University of Florida

Alexandira Brady-Mine, University of Florida

T. Bhattacharjee, S.M. Zehnder,K.G. Rowe, S. Jain, R.M. Nixon, W.G. Sawyer, T.E. Angelini (2015). Writing in the Granular Gel Medium, *Science Advances*, e1500655, 1-6 . http://advances.sciencemag.org/

Other

Redirect URL

Contributors

Crystal Tessmann
Hannah McCarthy (Assisted in developing the ELA questions during her internship in my classroom)
Kayla Sutcliff helped create the rubric
Kayla Bock helped teach the lesson and helped photograph

Supporting Program

Multidisciplinary Research Experiences for Teachers of Elementary Grades (PI: Prof. Chelsey Simmons), Herbert Wertheim College of Engineering, University of Florida

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Pre and post test items are based on test items for the Florida FCAT Science 2.0.

Classroom Testing Information

Give the pre-assessment and grade it for baseline data. Do not go over it before giving the post-test, as it can be used as a comparison.

This lesson was tested at J.J. Finley Elementary in Gainesville, Florida. The students were 19 fifth graders, ages ranging from 10 to 12. Testing took place in August and September of 2018.